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CENSUS OF BREEDING BIRDS AND POPULATION TRENDS OF THE DUPONT'S LARK *CHERSOPHILUS DUPONTI* IN EASTERN SPAIN

CENSO DE AVES REPRODUCTORAS Y TENDENCIA POBLACIONAL DE LA ALONDRA RICOTÍ *CHERSOPHILUS DUPONTI* EN ESPAÑA ORIENTAL

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SUMMARY.—We present the results of a breeding census of Dupont's Lark carried out in the Autonomous Community of Valencia in 2011 using the mapping method and an analysis of the recent trend for this population. The population was estimated at 44-47 males, located in five habitat patches of the Rincón de Ademuz, in zones where the species had been detected previously. Density in these patches fits within values expected according to the relation between patch size and density found in the populations of the nearby provinces. Comparison to previous studies reveals that population of Valencia has suffered an annual decline rate of around 10% on average, thus the implementation of a conservation plan is required to ensure the survival of the species in the study area.

RESUMEN.—Se presentan los resultados del censo de alondra ricotí reproductoras en la Comunidad Valenciana realizado en 2011 a través del método del mapeo, y un análisis de la tendencia poblacional reciente de dicha población. La población estimada fue de 44-47 machos, localizados en cinco áreas del Rincón de Ademuz, donde ya se había citado anteriormente. La densidad en estas áreas se ajusta a los valores esperados según la relación entre el tamaño del parche y la densidad media encontrada en las poblaciones de las provincias cercanas. La comparación con estudios anteriores revela que la población de Valencia sufre un declive anual de aproximadamente un 10% de media, por lo que es necesaria la creación de un plan de conservación para asegurar la supervivencia de la especie en la zona de estudio.

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The Dupont's lark *Chersophilus duponti* is one of the most endangered passerines in Europe. The European population, restricted to Spain, was estimated at 2,000-2,400 breeding pairs using censuses conducted between 2004 and 2007 (Suárez, 2010). Moreover, the species has experimented negative population trends, with several populations completely extinguished or declined in the last two decades (Tella *et al*., 2005; Suárez, 2010). Agricultural intensification, habitat loss, fragmentation, and reduced grazing pressure are the principal factors responsible for this decline (Suárez, 2010). Most studies on this species have been carried out in Soria and Ebro Valley, regions that are home to some of the healthiest European populations, while the knowledge of smaller populations is very scarce.

In the Autonomous Community of Valencia the presence of Dupont's lark was unknown until 1988, when 20 individuals were estimated in the Rincón de Ademuz (Garza and Suárez, 1990), to date the only locality in this region where this species is known to breed. This area is inserted among the populations of the adjacent provinces of Teruel and Cuenca, that occupy similar habitats, and is very likely connected with them. Due to the importance of this population, its small size and the limited knowledge that exists about it the main objective of this paper is to quantify the number of territorial males present in Valencia. We evaluate its density in comparison with populations of adjacent provinces and perform a review of the results of previous censuses to estimate population trends.

Methods

The Rincón de Ademuz is located in the southern extreme of the Sistema Ibérico, with slope orography and some flat areas dedicated to crops, especially almond trees *Prunus dulcis*, or scrub areas. The species has been cited in the municipalities of Vallanca and Castielfabib (Campos, 2003; Càdec, 2007), which are located at 1,100 m.a.s.l. and have a mean annual temperature of about 10 ºC and mean annual precipitation of 550 mm. The dominant vegetation is low scrub (*Rosmarinus officinalis, Lavandula stoechas, Genista scorpius*) with some pines *Pinus* spp. and junipers *Juniperus thurifera*.

Censuses were carried out in all potential habitats for the species, defined as the areas in which the species was found in previous studies or areas that presented flat reliefs, low scrub and had an extent larger than 10 ha (Garza *et al*., 2005; Seoane *et al*., 2006). Thirteen potential areas covering 1,457 ha were identified (table 1, figure 1). Twelve of these areas were counted in previous censuses (Campos, 2003; Càdec, 2007; Garza, 2010), and we added a new area (Casas Bajas) as a new possible location for the species. Plots were identified and named as in previous studies (Campos, 2003; Càdec, 2007). The localities defined in Suárez (2010) were greater than the ones used here and in one case overlapped the province of Valencia and Cuenca, thus for the estimation of population trends (see below) we selected the number of males detected in the smaller habitat patches that we have defined.

Censuses were conducted by the mapping method (Bibby *et al*., 2000). In each area we designed routes whose length and shape were sufficient to include their full extension within a 250 m maximum detection band on each side. Bird counts were carried out at dawn between March and June, and each area was walked completely three to eight times during this period (table 1). The density of Dupont's lark (males/10 ha) in each area was calculated by dividing the number of territories estimated in each area by patch size. We used the data published by Suárez (2010) on population sizes in habitat patches of Cuenca and Teruel to evaluate if the den-

TABLE 1

Sampling effort in the studied plots during the spring of 2011. For each plot the area, the number of times that each plot has been fully walked (counting rounds), the number of visits at dawn needed to complete a round (round length) and the length of the route defined within each plot are shown.
[Esfuerzo de muestreo en las parcelas estudiadas durante la primavera de 2011. Se detalla para cada parcela el área, número de veces que cada parcela ha sido censada en su totalidad, el número de visitas al amanecer necesarias para completar un censo y la longitud de la ruta definida dentro de cada parcela.]

Plot	Area (ha)	Complete counting rounds	Round length (days)	Route length (km)
Hontanar	198.9	6	2	6.0
Castellar	40.1	3	2	1.1
Tóvedas	74.1	3	1	2.4
Losar 1	178.4	8	2	5.1
Losar 2	15.9	3	1	2.0
Losar 3	59.0	4	2	4.0
Losar 4	34.1	3	1	1.7
Cerrillo 1	124.8	5	1	2.2
Cerrillo 2	77.4	3	1	3.3
Pinar 1	199.4	6	2	5.4
Pinar 2	160.4	3	2	2.5
Pinar 3	68.8	3	1	2.5
Casas Bajas	175.6	3	2	1.6
TOTAL	**1456.6**	**53**	**20**	**39.8**

sity estimated in Ademuz agrees with values expected in similar habitats of eastern Spain.

For each potential area that was found to be occupied by the species the instantaneous per capita growth rate, r (Mills, 2007), was calculated by comparing the data obtained in this study with previous works (Càdec, 2007; Garza, 2010). We used the same census methodology as Garza (2010), however Càdec (2007) used point-counts to estimate the species population. Pérez-Granados and López-Iborra (2011) found that this method overestimate the number of individuals registered through mapping methods and estimated the ratio between mapping and point count methods to be 0.78. Therefore, we used this ratio to correct the data from Càdec (2007) when used to calculate the growth rate. We have not included the study by Campos (2003) in these analyses because a different specific methodology was used for which a correction factor is not available. Data obtained by Garza (2010) in Tóvedas were also excluded because only one male was located. Instantaneous growth rate was calculated as follows: $\left(\ln(N_p) - \ln(N_{2011})\right)$/years,

FIG. 1.—Location of the potential habitat areas identified in Rincón de Ademuz (polygons within Valencia Province identified by their name), and location of the nearest populations outside of Valencia (larger polygons) in the provinces of Cuenca and Teruel.
[Localización de las áreas de hábitat potencial identificadas en el Rincón de Ademuz (polígonos en la provincia de Valencia e identificados por su nombre), y localización de las poblaciones más cercanas fuera de Valencia (polígonos mayores) en las provincias de Cuenca y Teruel.]

where N_p is the estimated population for one area in the previous census, N_{2011} is the estimated population from this study in the same area in 2011, and years is the number of years between censuses. If $N_{2011} = 0$ we used this value instead of the natural logarithm.

RESULTS

During the breeding season of 2011 we estimated 44-47 territories, in five of eight localities in which this species was present during the previous censuses (table 2). Two of

TABLE 2

Number of territories of Dupont's lark found in each plot and density (males/10 ha) calculated for the results of the present study. Annual variation shows the instantaneous per capita growth rate calculated in each area for the interval between the time the previous studies of Garza (2010) and Càdec (2007) and (2011). For these calculations data from Càdec (2007) were multiplied by 0.78 (see text for more detail). In the Garza (2010) study: a = 2004 census; b = 2006 census. The total row shows the total number of territories estimated and the averages for density in 2011 and instantaneous *per capita* growth rates.
[Número de territorios de alondra ricotí encontrados en cada parcela y densidad (machos/10 ha) calculada según los resultados del presente estudio. La variación anual muestra la tasa instantánea de crecimiento per capita calculada en cada área para el intervalo de tiempo transcurrido entre los estudios de Garza (2010) y Càdec (2007) y (2011). Para estos cálculos, los datos de Càdec (2007) fueron multiplicados por 0,78 (véase texto para más detalles). En el estudio de Garza (2010): a = censo de 2004; b = censo de 2006. La columna "total" muestra el número total de territorios estimado y las medias de la densidad en 2011 y de las tasas instantáneas de crecimiento per capita.*]*

Plot	**Campos (2003)**	**Garza (2010)**	**Càdec (2007)**	**Present paper**		**Annual variation**	
Census year	**2003**	**2004[a]-2006[b]**	**2007**	**2011**	**Males/ 10 ha**	**2004-06/ 2011**	**2007/ 2011**
Hontanar	27-43	11-14[a]	36	11-12	0.58	–0.012	–0.223
Castellar	–	–	0	0	0	–	–
Tóvedas	–	1[a]	4	0	0	–	–0.284
Losar 1	0	13-14[b]	25	12	0.67	–0.024	–0.121
Losar 2	–	–	0	0	0	–	–
Losar 3	–	–	4	7-8	1.27	–	0.219
Losar 4	–	–	0	0	0	–	–
Cerrillo 1	5-8	0-5[a]	9	1-2	0.12	–0.073	–0.386
Cerrillo 2	–	–	0	0	0	–	–
Pinar 1	50	20[a]	17	13	0.65	–0.061	–0.005
Pinar 2	–	2[a]	3	0	0	–0.099	–0.213
Pinar 3	–	5[a]	–	0	0	–0.229	–
Casas Bajas	–	–	–	0	0	–	–
TOTAL	**82-101**	**53-62**	**98**	**44-47**	**0.65**	**–0.083**	**–0.145**

the largest population were found in *Thymus* scrubland (Hontanar and Pinar 1), a typical habitat for the species, but other *Thymus* scrublands presented small populations and low density, such as in the case of Cerrillo 1 (table 2). Losar 1 and Losar 3 are located in a *Rosmarinus officinalis* dominated scrubland, and present a similar density to some of the *Thymus* areas (table 2). Dupont's lark densities in our study area are within the range expected for their habitat patch size (fig. 2) according to the data of the nearby populations of Cuenca and Teruel.

The mean instantaneous growth rate per capita (r) calculated from the Càdec (2007) data was –0.145 (SE = 0.070; range: –0.386 to 0.219), but since one of the populations increased in 2011 (Losar 3) the mean r value is not significantly different from zero ($t = -1.91$, $df = 6$, $P = 0.105$). The mean r value obtained with the Garza (2010) data was –0.083 (SE = 0.032; range: –0.229 to –0.012), which is significantly different from zero ($t = -2.59$, $df = 5$, $P = 0.048$).

Discussion

The Dupont's lark population estimated in this paper is the lowest ever recorded for Autonomous Community of Valencia (Campos, 2003; Càdec, 2007; Garza, 2010). There-

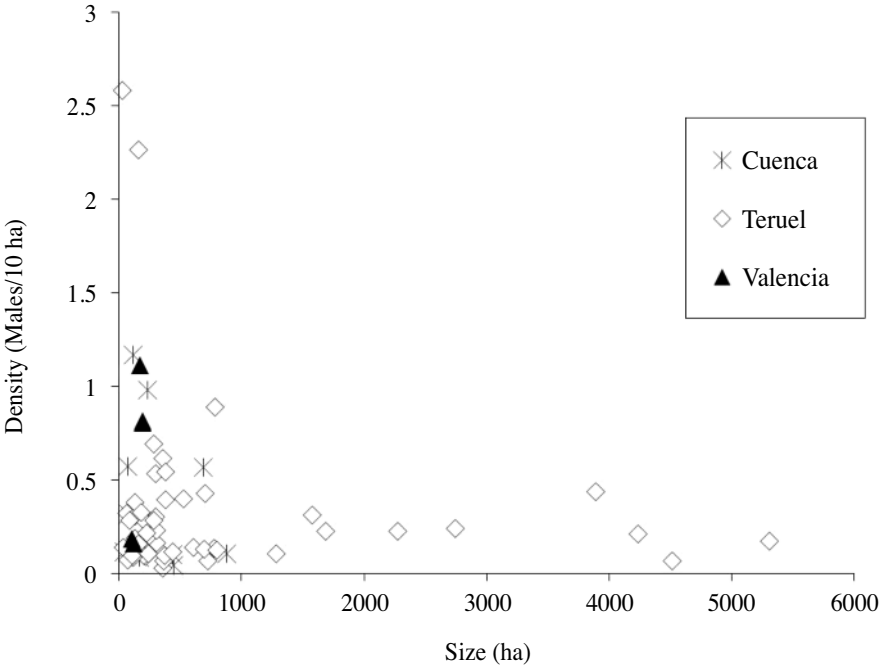

Fig. 2.—Dupont's lark density (males/10 ha) estimated in different areas in the province of Valencia (present study) and in the neighbouring provinces (Cuenca and Teruel; Suárez, 2010) in relation to the extension of the habitat patch.
[Densidad estimada de alondra ricotí (machos/10 ha) en diferentes áreas en la provincia de Valencia (presente estudio) y en las provincias colindantes (Cuenca y Teruel; Suárez, 2010) con relación a la extensión del tamaño del parche.]

fore, it is possible that in this region this species is undergoing a rarefaction and extinction process, as has been shown to occur in many small and peripheral populations (Tella *et al*., 2005; Suárez, 2010). The absence of the species in some areas where it had been previously detected, producing a 31.5% contraction of its area of occupancy, supports this hypothesis.

The mean density obtained in this paper in occupied areas (0.65 males/10 ha) is higher than the mean density estimated in other Spanish regions (averages between 0.27-0.30 males/10 ha in Aragón, Castilla y León and Castilla-La Mancha; 0.27 males/10 ha in all of Spain; Suárez, 2010), but lower than the mean densities of the species in the Ebro Valley (1.37 males/10 ha, Vögeli *et al*., 2010) or in Layna moorland (1 male/10 ha, Garza *et al*., 2005). Vögeli *et al*. (2010) showed in the Ebro Valley that Dupont's lark density was low and fairly constant in habitat patches larger than 200 ha, while it is more variable and reaches greater values in smaller habitat patches. Our analysis shows the same pattern for Cuenca and Teruel, which may be interpreted as an indicator of the existence of dispersal limitations that produce an increase of density as the area of habitat patches shrinks (Tischendorf *et al*., 2005; Laiolo and Tella, 2006; Vögeli *et al*., 2010). In Ademuz, all the patches were smaller than 200 ha (mean 108 ha), which may explain the relative high density obtained. In conclusion, the Dupont's lark population in Valencia does not present unusually low densities, although they seem to have been higher in the recent past, and the contraction of its area of occupancy also played an important role in its decline.

The average estimated annual decline rate is high, around 10%, and points to a rapid decrease of the species in Valencia. However the number of males in one of the areas studied increased between 2007 and 2011 and there are some uncertainties associated with the different methodologies used, thus a longer time series is needed to specify this rate. Despite this, it is an alarming result because with these values the species could be extinct in the study area in 20-30 years. It is worth mentioning that the only known population in Catalonia was of a size similar to the study population in 1994 (50-60 pairs) and decreased to 15-20 pairs by 2001, with an instantaneous growth rate equal to 0.164. This population became extinct in 2005 (Suárez, 2010).

The Dupont's lark population in Valencia is severely endangered due to its low number of individuals and intense recent decline. At the moment, only 60% of the plots in which the species was present and 69% of its area of occupancy are included within Special Protection Areas for Birds. Therefore, it is of vital importance that there is rapid implementation of a conservation plan for the species by the Autonomous Community of Valencia. This should follow the guidelines of the Action Plan in the European Union (Iñigo *et al*., 2008), and should include the different conservation assessments proposed within it.

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